CLAIMS

1. A polyether polyol formed according to a process comprising the steps of:

a) providing at least one alkylene oxide;

b) providing at least one initiator molecule having at least one alkylene oxide reactive hydrogen; and

c) reacting the at least one alkylene oxide with the at least one initiator molecule in the presence of an aluminum phosphonate catalyst to form a polyether polyol.

2. The polyether polyol of Claim 1, wherein step a) comprises providing ethylene oxide, propylene oxide, butylene oxide, epichlorohydrin or mixtures of these alkylene oxides.

3. The polyether polyol of Claim 1, wherein step b) comprises providing as the at least one initiator molecule, an alcohol, a polyhydroxyl compound, a mixed hydroxyl and amine compound, a polyamine compound, or mixtures of these initiator molecules.

4. The polyether polyol of Claim 1, wherein

a) step b) comprises providing as the at least one initiator molecule, an oligomer comprising the reaction product of a pre-reaction initiator molecule with at least one alkylene oxide and

b) step c) comprises using the oligomer as the initiator molecule.

5. The polyether polyol of Claim 4, wherein said oligomer has a number average molecular weight of from 200 to 1500 Daltons.

6. The polyether polyol of Claim 1, wherein step c) comprises providing the aluminum phosphonate catalyst in an amount of from 0.1 to 5.0 weight percent based on the total weight of the polyether polyol.

7. The polyether polyol of Claim 1, wherein step c) comprises providing as the aluminum phosphonate catalyst an aluminum phosphonate having the general structure of $RPO-(OAlR'R'')_2$ wherein: O represents oxygen; P represents pentavalent phosphorous; Al represents aluminum; R comprises a hydrogen, an aryl group; and R' and R" independently comprise a halide, an alkyl group, an alkoxy group, an aryl group, or an aryloxy group.

8. The polyether polyol of Claim 7, comprising providing as the aluminum phosphonate catalyst an aluminum phosphonate wherein: R is a methyl group; and R' and R" independently comprise one of an ethyl group, an ethoxy group, a propyl group, a propoxy group, a butyl group, a butoxy group, a phenyl group, or a phenoxy group.

9. The polyether polyol of Claim 1, wherein step c) comprises reacting the at least one alkylene oxide with the at least one initiator molecule in the presence of the aluminum phosphonate catalyst to form a polyether polyol having an unsaturation of less than or equal to 0.020 meq/g KOH

10. The polyether polyol of Claim 1, wherein step c) comprises reacting the at least one alkylene oxide with the at least one initiator molecule in the presence of the

aluminum phosphonate catalyst to form a polyether polyol having an unsaturation of less than or equal to 0.015 meq/g KOH.

11. The polyether polyol as recited in Claim 1, wherein step c) comprises reacting the at least one alkylene oxide with the at least one initiator molecule in the presence of the aluminum phosphonate catalyst for a period of time sufficient to produce a polyether polyol having a number average molecular weight of from 1500 to 8000 Daltons.

12. A polyether polyol formed according to a process comprising the steps of:

a) providing at least one alkylene oxide;

b) providing at least one initiator molecule having at least two alkylene oxide reactive hydrogens;

c) providing an aluminum phosphonate catalyst having the general structure of $RPO\text{-}(OAlR'R'')_2$ wherein: O represents oxygen; P represents pentavalent phosphorous; Al represents aluminum; R comprises a hydrogen, an alkyl group, or an aryl group; and R' and R" independently comprise a halide, an alkyl group, an alkoxy group, an aryl group, or an aryloxy group; and

d) reacting the at least one alkylene oxide with the at least one initiator molecule in the presence of the aluminum phosphonate catalyst to form a polyether polyol.

13. The polyether polyol of Claim 12, wherein step a) further comprises providing ethylene oxide, propylene oxide, butylene oxide, epichlorohydrin or mixtures of these alkylene oxides.

14. The polyether polyol of Claim 12, wherein step b) comprises providing as the at least one initiator molecule a polyhydroxyl compound, a mixed hydroxyl and amine compound, a polyamine compound, or mixtures of these initiator molecules.

15. The polyether polyol of Claim 12, wherein

a) step b) comprises providing as the at least one initiator molecule, an oligomer comprising the reaction product of a pre-reaction initiator molecule with at least one alkylene oxide and

b) step c) comprises using the oligomer as the initiator molecule.

16. The polyether polyol of Claim 12, wherein said oligomer has a number average molecular weight of from 200 to 1500 Daltons.

17. The polyether polyol of Claim 12, wherein step c) comprises providing the aluminum phosphonate catalyst in an amount of from 0.1 to 5.0 weight percent based on the total weight of the polyether polyol.

18. The polyether polyol of Claim 12, wherein step c) comprises providing as the aluminum phosphonate catalyst an aluminum phosphonate wherein:

R is a methyl group; and

R' and R" independently comprise one of an ethyl group, an ethoxy group, a propyl group, a propoxy group, a butyl group, a butoxy group, a phenyl group, or a phenoxy group.

19. The polyether polyol of Claim 12, having an unsaturation of less than or equal to 0.020 meq/g KOH

20. The polyether polyol of Claim 12, having an unsaturation of less than or equal to 0.015 meq/g KOH.

21. The polyether polyol as recited in Claim 12, having a number average molecular weight of from 1500 to 8000 Daltons.

22. A polyether polyol formed according to a process comprising the steps of:

a) providing propylene oxide;

b) providing at least one initiator molecule having at least one propylene oxide reactive hydrogen; and

c) reacting the propylene oxide with the at least one initiator molecule in the presence of an aluminum phosphonate catalyst to form a polyether polyol.

23. The polyether polyol of Claim 22 comprising the further step of reacting the polyether polyol formed in step c) with ethylene oxide in the presence of an aluminum phosphonate catalyst to thereby form terminal caps of ethylene oxide.

24. The polyether polyol of Claim 22 further comprising terminal caps of ethylene oxide.

25. The polyether polyol of Claim 23 or 24 comprising terminal caps of ethylene oxide in an amount of from 5 to 80% by weight based on the total weight of the polyether polyol.

26. The polyether polyol of Claim 22 wherein step b) comprises providing at least one diol initiator molecule having at least two propylene oxide reactive hydrogens.

27. A heteric polyether polyol formed according to a process comprising the steps of:

a) providing a mixture of alkylene oxides;

b) providing at least one initiator molecule having at least one alkylene oxide reactive hydrogen; and

c) reacting the mixture of alkylene oxides with the at least one initiator molecule in the presence of an aluminum phosphonate catalyst to form a heteric polyether polyol.

28. The heteric polyether polyol of Claim 27 comprising the further step of reacting the heteric polyether polyol formed in step c) with ethylene oxide or propylene oxide in the presence of an aluminum phosphonate catalyst to thereby form terminal caps.

29. The heteric polyether polyol of Claim 27 further comprising terminal caps of ethylene oxide and/or propylene oxide.

30. The heteric polyether polyol of Claim 28 or 29 wherein said terminal caps of comprise ethylene oxide in an amount of from 5 to 20% by weight of the total weight of the polyether polyol.

31. The heteric polyether polyol of Claim 28 or 29 wherein said terminal caps comprise propylene oxide in an amount of from 5 to 15% by weight of the total weight of the polyether polyol.

32. A polyether polyol formed according to a process comprising the steps of:

a) providing ethylene oxide;

b) providing at least one initiator molecule having at least one ethylene oxide reactive hydrogen; and

c) reacting the ethylene oxide with the at least one initiator molecule in the presence of an aluminum phosphonate catalyst to form a polyether polyol.

33. The polyether polyol of Claim 32 comprising the further step of reacting the polyether polyol formed in step c) with propylene oxide in the presence of an aluminum phosphonate catalyst to thereby form terminal caps of propylene oxide.

34. The polyether polyol of Claim 32 further comprising terminal caps of propylene oxide.

35. The polyether polyol of Claim 33 or 34 wherein said terminal caps of propylene oxide comprise from 5 to 80% by weight of the total weight of the polyether polyol.

36. A polyether polyol formed according to a process comprising the steps of:

a) providing at least one alkylene oxide;

b) providing at least one oligomer having at least one alkylene oxide reactive hydrogen; and

c) reacting the at least one alkylene oxide with the at least one oligomer in the presence of an aluminum phosphonate catalyst to form a polyether polyol.

37. The polyether polyol of Claim 36 wherein said at least one oligomer has a number average molecular weight of from 200 to 1500 Daltons.

38. A modified polyether polyol comprising terminal caps, said terminal caps formed according to a process comprising the steps of:

a) providing a polyether polyol; and

c) reacting the polyether polyol with at least one alkylene oxide in the presence of an aluminum phosphonate catalyst to form a modified polyether polyol having terminal caps comprising the alkylene oxide.

39. The modified polyether polyol of Claim 38 wherein said terminal caps comprise ethylene oxide, propylene oxide, epichlorohydrin, or mixtures of these alkylene oxides.

40. The modified polyether polyol of Claim 38 comprising providing a polyether polyol having a number average molecular weight of from 500 to 10,000 Daltons in step a).

41. A linear block copolymer polyether polyol formed according to a process comprising the steps of:

a) providing a first alkylene oxide;

b) providing at least one diol initiator molecule having two alkylene oxide reactive hydrogens; and

c) reacting the first alkylene oxide with the at least one diol initiator molecule in the presence of an aluminum phosphonate catalyst to form a linear polyether polyol; and

d) reacting the reaction product of step c) with a second alkylene oxide other than the first alkylene oxide in the presence of the aluminum phosphonate catalyst to form a linear block copolymer polyether polyol.

42. The polyether polyol of Claim 41, wherein the first alkylene oxide and the second alkylene oxide are selected from the group consisting of ethylene oxide, propylene oxide, butylene oxide and mixtures thereof such that the first alkylene oxide is different from the second alkylene oxide.

43. A composition of matter comprising:

a) a polyether polyol and

b) an aluminum phosphonate having the general structure of $RPO-(OAlR'R'')_2$ wherein:

P represents pentavalent phosphorous;

R comprises a hydrogen, an alkyl group, or an aryl group; and

R' and R" independently comprise a halide, an alkyl group, an alkoxy group, an aryl group, or an aryloxy group.

44. The composition of matter as recited in Claim 43 wherein:

R is a methyl group; and

R' and R" independently comprise one of an ethyl group, an ethoxy group, a propyl group, a propoxy group, a butyl group, a butoxy group, a phenyl group, or a phenoxy group.

45. The composition of matter as recited in Claim 43, wherein said aluminum phosphonate is present at levels of from approximately 0.01 to 5.0 weight percent based on the total weight of the polyether polyol.

46. A polyether polyol comprising the reaction product of propylene oxide and at least one initiator molecule having at least one propylene oxide reactive hydrogen, wherein said polyol consists essentially of molecules having an equivalent weight of 1000 to 2000 Daltons and an unsaturation of less than or equal to 0.020 meq/g KOH.

47. A polyether polyol comprising the reaction product of propylene oxide and at least one initiator molecule having at least one propylene oxide reactive hydrogen, reacted in the presence of an aluminum phosphonate catalyst to form a polyether polyol comprising:

an equivalent weight of 1000 to 2000 Daltons; and

an unsaturation of less than or equal to 0.020 meq/g KOH.

48. The polyether polyol of Claim 47 wherein the equivalent weight ranges from 1000 to 1500 and the unsaturation is less than or equal to 0.015 meq/g KOH.

49. The polyether polyol of Claim 47 wherein the at least one initiator molecule comprises an oligomer or a polyol.

50. A polyether polyol comprising the reaction product of propylene oxide and at least one initiator molecule having at least one propylene oxide reactive hydrogen reacted in the absence of DMC catalyst, wherein said polyol consists essentially of molecules having an equivalent weight of 1000 to 2000 Daltons and an unsaturation of less than or equal to 0.020 meq/g KOH.

51. A polyether polyol comprising the reaction product of:

a) at least one alkylene oxide;

b) at least one initiator molecule having at least one alkylene oxide reactive hydrogen;

reacted in the presence of an aluminum phosphonate catalyst.

52. The polyether polyol of Claim 51, wherein the at least one alkylene oxide comprises ethylene oxide, propylene oxide, butylene oxide, epichlorohydrin or mixtures of these alkylene oxides.

53. The polyether polyol of Claim 51, wherein the at least one initiator molecule comprises an alcohol, a polyhydroxyl compound, a mixed hydroxyl and amine compound, a polyamine compound, or mixtures of these initiator molecules.

54. The polyether polyol of Claim 51 having an unsaturation of less than or equal to 0.020 meq/g KOH

55. The polyether polyol of Claim 51, wherein said at least one initiator molecule comprises a polyether.

56. The polyether polyol of Claim 51, wherein the at least one alkylene oxide comprises at least two of ethylene oxide, propylene oxide, butylene oxide, epichlorohydrin or mixtures of these alkylene oxides.

57. A polyether polyol comprising the reaction product of:

a) a first alkylene oxide reacted with at least one initiator molecule having at least one alkylene oxide reactive hydrogen; and

b) a second alkylene oxide, different from said first alkylene oxide;

reacted in the presence of an aluminum phosphonate catalyst.

58. The polyether polyol of claim 57 wherein the first alkylene oxide and the second alkylene oxide are selected from the group consisting of ethylene oxide, propylene oxide, butylene oxide and mixtures thereof such that the first alkylene oxide is different from the second alkylene oxide.

59. The polyether polyol of Claim 58 comprising a block copolymer polyether polyol.

60. The polyether polyol of Claim 58 comprising a terminal capped polyether polyol.